

Marine Nearshore

Protocol: Marine Nearshore Integrated Protocol

Parks Where Protocol Will Be Implemented: KATM, KEFJ, LACL

Vital Signs Addressed: This protocol will address seven vital signs [Kelp and Eelgrass, Marine Intertidal Invertebrates, Seabirds, Black Oystercatcher (*Haematopus bachmani*), Sea Otter (*Enhydra lutris*), River Otter (*Lutra canadensis*), and Marine Water Quality]. The protocol will contain approximately 30 standard operating procedures (SOPs).

Justification/Issues Being Addressed: The marine coastline of SWAN spans 1,900 kilometers in the Northern Gulf of Alaska and contains almost one-third of the marine coastline in the national park system. The marine nearshore zone is defined as that portion of the park's marine coastline that stretches from the high tide line to approximately 65-ft (20-m) depth. The intertidal and subtidal areas of the nearshore habitat are brackish and saltwater coastal habitats that are some of the most productive in the Gulf of Alaska and are highly susceptible to anthropogenic perturbations. Nearshore habitats provide important feeding grounds for larger animals such as sea otter and brown bears (*Ursus arctos*) and provide nurseries for marine organisms. Contaminants such as persistent organic pollutants may be found in high concentrations in invertebrate species of the nearshore, providing pathways and potential threats to wildlife and human health.

In partnership with the USGS-BRD Alaska Science Center, USFWS, NMFS, and State of Alaska, SWAN will develop protocols and monitoring strategies for implementation of the Gulf Ecosystem Monitoring (GEM) initiative being developed by the *Exxon Valdez* Oil Spill Trustee Council (EVOS). The flagship of the GEM program will be a core monitoring program, which, when combined with the monitoring efforts of other resource agencies and research entities, will help detect environmental change over time and greatly expand understanding of the Gulf of Alaska ecosystems. The GEM conceptual framework for marine nearshore monitoring has the following elements:

- 1) **synoptic**—monitor a few variables everywhere, i.e., remotely and quickly sample large areas; most balanced sampling;
- 2) **extensive**—monitor many variables in few places, i.e., broad range of measurements at few sites across large area; detects large scale changes; and
- 3) **intensive**—monitor mid range of variables over moderate range of sites, i.e., fewer measurements, more areas, smaller spatial coverage; detects small-scale changes.

The vital signs and metrics to be sampled include both biological and physical elements. Plant and invertebrate species were selected that are numerically dominant, structurally important, or critical prey of specified nearshore vertebrate predators. These species were also selected because they provide a sound statistical basis for detecting change in a cost-efficient manner (Houghton et al. 1993, Highsmith et al. 1994). Physical variables to be measured will include shoreline geomorphology, water temperature, air temperature, and salinity.

Kelp and Eelgrass, along with other seagrasses, are “living habitats” that serve as a nutrient filter, provide understory and ground cover for planktivorous fish, clams, and urchins, and a physical substrate for invertebrates and algae. Kelp plants are the major primary producers in the marine nearshore, and because they are located in shallow water they could be significantly affected should there be an oil spill. Other stresses include activities that disturb the beds directly, such as dredging and anchor scars, and events that reduce the ability of light to penetrate into the water column, such as runoff (increased turbidity) or nutrient addition.

Marine Intertidal Invertebrates provide a critical prey resource for shorebirds, ducks, fish, bears, sea otters, and other marine invertebrate predators, as well as a spawning and a nursery food source for forage fish and juvenile crustaceans. Benthic invertebrates are ecologically diverse in terms of habitat and trophic requirements, have a wide range of physiological tolerances and feeding modes, are relatively sedentary, and have short generation times. They are therefore good biological indicators and generally respond much more rapidly than fishes to changes in environmental conditions.

Seabirds and sea ducks are predators near the top of marine nearshore food webs. Marine birds are long-lived, conspicuous, abundant, widespread members of the marine ecosystem and are sensitive to change. Because of these characteristics, marine birds are good indicators of change in the marine ecosystem. Many studies have documented that their behavior, diets, productivity, and survival change when conditions change. Public concern exists for the welfare of seabirds because they are affected by human activities such as oil pollution and commercial fishing.

Black Oystercatchers are well suited for inclusion into a long-term monitoring program of nearshore habitats because they are long-lived; reside and rely on intertidal habitats; consume a diet dominated by mussels, limpets, and chitons; and provision chicks near nest sites for extended periods. Additionally, as a conspicuous species sensitive to disturbance, the black oystercatcher would likely serve as a sentinel species in detecting change in the nearshore community resulting from human or other disturbances.

Sea Otters (western Alaska stock) were federally listed on September 2005 as threatened. Sea otters dramatically change the structure and complexity of their nearshore ecological community and are a prime example of the top-down cascade type of food chain in which the highest trophic level can determine the populations of the lower trophic levels. Sea otters tend to be relatively sedentary in comparison to other marine mammals, eat large amounts of food, have an incidence of disease that is correlated with contaminants, and have broad appeal to the public.

River Otters live in coastal environments and select habitats close to the shore, where their chief food items are marine bottom-dwelling fishes. In the aftermath of EVOS, studies of coastal river otters in Prince William Sound indicated that they are a keystone species for the land-margin ecosystem and a “sentinel species” for monitoring levels of environmental contamination.

Marine Water Chemistry, including temperature and salinity, are critical to intertidal fauna and flora and are likely to be important determinants of both long-term and short-term fluctuations in the intertidal biotic community. Basic water quality parameters provide a record of environmental conditions at the time of sampling and are used in assessing the condition of biological assemblages.

Specific Monitoring Questions and Objectives to be Addressed by the Protocol:

Kelp and Eelgrass

Question:

- What are annual trends in the abundance, distribution, and composition of kelp, eelgrass, and surfgrass?

Objective:

- Estimate long-term trends in abundance and distribution of kelp and seagrass.

Marine Intertidal Invertebrates

Questions:

- How is the annual composition and relative abundance of sessile and motile invertebrates changing in the intertidal zone?
- How is the concentration of contaminants changing in mussel tissue?

Objectives:

- Monitor long-term trends in invertebrate species richness.
- Document how the size distribution of limpets (*Tectura persona*) and mussels (*Mytilus trossulus*) is changing annually.
- Estimate long-term trends in abundance of littleneck clam (*Protothaca staminea*).
- Document how the size distributions and growth rates of littleneck clams are changing annually.
- Monitor status and trends in the concentration of metals, organochlorides, PCBs, and mercury in mussel tissue.

Seabirds

Question:

- How is the abundance of birds closely linked to the nearshore, especially harlequin ducks (*Histrionicus histrionicus*) and Barrow's goldeneye (*Bucephala islandica*), changing annually during summer and winter?

Objective:

- Estimate long-term trends in the seasonal abundance of seabirds and sea ducks.

Black Oystercatcher

Question:

- How is the relative density (pairs/linear mile [km] of shoreline) of black oystercatcher nests (breeding territories) changing annually?

Objective:

- Estimate long-term trends in relative density of black oystercatchers.

Sea Otter

Questions:

- How is abundance of sea otters changing annually? Where? Which park coastlines/nearshore areas?
- How is age-specific survival of sea otters changing annually? Where? Which park coastlines/nearshore areas?

Objectives:

- Estimate long-term trends in sea otter abundance.
- Estimate and compare age-specific survival rates of sea otters among regions within the Gulf of Alaska.

River Otter

Question:

- How is the distribution and relative abundance of coastal river otters changing annually?

Objective:

- Estimate long-term trends in river otter abundance.

Marine Water Chemistry

Questions:

- How are seasonal and annual patterns of sea surface temperature, chlorophyll a standing stock, sediment levels, and flow patterns changing in nearshore waters of Shelikof Strait, Lower Cook Inlet, and the Outer Kenai Peninsula?
- What is the daily, seasonal, and annual variation in intertidal and subtidal water temperature and salinity and how are they changing over time?

Objectives:

- Acquire regional synoptic nearshore oceanographic data collected by the Alaska Ocean Observing System (AOOS) and incorporate into regional (SWAN) data sets.
- Document daily, seasonal, and annual variability and gradients in temperature and salinity at randomly selected shallow water (< 65 ft [< 20 m]) nearshore sampling sites.

Basic Approach: In January 2004, a report was submitted to the *Exxon Valdez* Oil Spill Trustee Council that outlined several alternative sampling designs for monitoring in the nearshore (Bodkin and Dean 2003). The next phase in the effort to implement a nearshore monitoring plan requires that specific sampling sites be selected and specific SOPs be developed for each Vital Sign.

Kelp and Eelgrass Seagrasses are monitored in many regions as an indicator of nearshore habitat quality by comparing maps of resource abundance and distribution over time. An existing protocol using low-tide, oblique aerial video imagery (Harper and Morris 2004) will be used to document annual and decadal changes in occurrence and distribution of seagrasses along the entire intertidal length of the coastline. Each video frame is georeferenced with GPS coordinates. Biological mappers provide an inflight, synchronous narration of shore-zone features to supplement the imagery (e.g., identification of eelgrass or kelp in the shallow, subtidal zone).

Marine Intertidal Invertebrates Protocols for transect and quadrat-based sampling of intertidal invertebrates exist. The overall approach will be to select subsampling unit sizes such that the mean abundance per subsampling unit (for dominant species) would be large enough to afford reasonable power to detect change, but not so large as to be excessively time-consuming and inefficient. The smallest subsampling unit (2.7 ft² [0.25 m²]) is larger than those used by Highsmith et al. (1994), which were found to have reasonable power to detect changes for these numerically dominant species following the *Exxon Valdez* oil spill (Peterson et al. 2001). Sampling sites are defined as 328 ft (100 m) stretches of coastline with contiguous sheltered rocky or mixed sand/gravel habitat. The approximate location of each site will be predetermined using existing shoreline maps and habitat data.

Mussels (*Mytilus trossulus*) will be collected from sheltered rocky intertidal sites (10 systematic sites within each block plus 18 selected sites). The meat of the mussels will be removed, the samples from each site combined, and the composite sample analyzed to determine the concentration of contaminants. The chemical analyses will consist of a metals screen, an organic carbon screen, a fluorescent aromatic hydrocarbon screen, and mercury analyses.

Seabirds Survey methodology will conform to established procedures used in the Gulf of Alaska to estimate the abundance of nearshore seabirds from small skiffs (Irons et al. 1988, 2000, Lance et al. 2001). The marine waters within 656 ft (200 m) of land will be divided into discrete transects and identified by geographic features, such as points of land, to facilitate orientation in the field and to separate the shoreline by habitat (Irons et al. 1988). Shoreline transects will vary in size, ranging from small islands with < 0.62 mi (< 1 km) of coastline to sections of the mainland with more than 18.6 mi (30 km) of coastline. All transects will be sampled in March and July, and the same transects will be sampled each year.

Black Oystercatcher Andres (1998) has developed boat-based survey techniques for black oystercatchers. A survey of all shoreline habitats will be conducted in mid-May, the location of all black oystercatchers will be mapped on aerial photographs, and GPS locations will be recorded. Locations with territorial pairs will be searched extensively by foot for nests. This intensive survey will be repeated once both in June and in July in an effort to locate all oystercatcher nests throughout the nesting season.

Sea Otters An SOP for sea otter surveys has been developed by Bodkin and Monson (1999) and involves: (i) aerial strip transect counts and (ii) aerial intensive search units. Sea otter habitat is sampled in two strata, high density and low density, distinguished by distance from shore and depth contour. Intensive

search units are flown at intervals dependent on sampling intensity throughout the survey period to obtain a sightability correction factor.

River Otters Relative abundance of river otters can be generated by surveying and documenting the distribution and use of latrine sites (Bowyer et al. 2003). Ben-David et al. (2005) are currently testing scat deposition rates (i.e., scats deposited/day) at latrines for estimating river otter population levels and trends among different areas of coastline in SWAN.

Marine Water Chemistry Satellites will be used for synoptic measurements of surface temperature and turbidity. Visible remote sensing (i.e., ocean color) will be used to infer the chlorophyll a standing stock, sediment levels, and flow patterns. Water temperature will be measured continuously (spring-fall) with Hobo data loggers at middle intertidal stations near long-term sheltered rocky and mixed sand/gravel sampling sites. Offshore water quality information will be provided by other programs, including AOOS, Alaska Department of Fish and Game, National Oceanic and Atmospheric Administration, Coastal Management Institute, and the Cook Inlet Regional Citizen Advisory Council.

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- David Irons, USFWS (Seabirds)
- Brad Andres, USFWS (Black Oystercatcher)
- Merav Ben-David, Univ. of Wyoming (River Otter)
- Mandy Lindeberg, NMFS-Auke Bay Lab (Water Quality/Contaminants)
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Development Schedule, Budget, and Expected Interim Products:

- 2006 Draft SOPs and protocols, revise, and finalize GEM/SWAN Nearshore Monitoring Plan (\$35,000).
- 2007 Test protocols and make final selection of monitoring sites (\$70,000).
- 2008 Implement Nearshore Monitoring Plan (\$ to be determined).

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